Space Weather Technical Forecast

Issued on Saturday 9 November 2024 at 13:27 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate solar activity is likely, with a slight chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with both peak and baseline X-Ray flux within C-class levels in the past 24 hours.

There are currently eight sunspot regions on the visible disc. There are two large and complex regions present. AR3889, in the southeast, contains a number of of mature spots and including at least one delta configuration in its trailing region, now displaying an open structure. AR3883, in the southwest, has mature leading and trailing spots, but has seen some decay in the spots occupying the intermediate region and the delta spot appears to continue fading. AR3886, in the southeast, approaching centre-disc, is a sparsely populated spot that consists of a number of small, mature spots and clusters of weaker spots extending over a wide longitudinal and latitudinal area. This spot also continues a slow decline in penumbral area. AR3879 continues as a large single mature spot in the northwest, but has been inactive. The remaining spot regions are smaller and more magnetically simple.

No definitive Earth-directed CMEs were observed, however, several minor 'dimming' events were observed on 08 Nov in the vicinity of AR3883 and AR3886, near centre-disc in the southern hemisphere. Although available coronagraph imagery did not indicate any clear Earth-directed CMEs, some faint ejecta cannot be completely discounted as having some Earth-directed trajectory.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE and DSCOVR were indicative of magnetic cloud and perhaps CH HSS influences. Wind speeds were between slightly elevated and background, around 360-450 km/s. Density was above average or above, with peak 22 ppcc measured at 09/2300 UTC. The Interplanetary Magnetic Field (IMF), Bt, was Moderate to Strong throughout, between 8-17nT, with peak values seen around 09/0700 UTC. The north-south component, Bz, was mostly southward (negative) directed and Weak to Moderate, around +8 to -12nT. Phi angle was generally negative (toward the Sun), but became mostly positive (away from the Sun) after 09/0845 UTC. Resultant Geomagnetic Activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at

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background levels throughout. The associated 24-hour fluence was well below the Active threshold, with 1.14e6 integrated flux observed at 09/1200UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast, with a likelihood of M-class flares and a slight chance of X-class flares, most probably from AR3883 or AR3889.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast. Solar winds are currently Slightly Elevated due to ongoing CME and perhaps coronal hole high speed stream influences. Slightly Elevated solar wind speeds are considered most likely, around 400-450 km/s before easing on Day 2 (10 Nov). The HSS from CH88/+ may connect late Day 1 (09 Nov) or on Day 2 (10 Nov) until Day 3 (11 Nov), bringing Slightly Elevated to Elevated solar wind speeds if it does. Speeds should trend back towards background levels during Day 4 (12 Nov).

Generally Quiet to Unsettled (Kp1-3) activity is forecast but with Active (Kp4) intervals likely and a slight chance of peak G1/Minor Storm conditions, mainly between Days 1-3 (09-11 Nov) due to generally minor CME and HSS influence.

Energetic Particles / Solar Radiation: High energy proton flux at GOES-18 is at normal background levels. There is a rising slight chance of S1/Minor Proton Storms or greater as many the larger regions on the disk rotate into more geoeffective positions in the western hemisphere. The high energy electron flux is expected to remain background to Moderate at first, then potentially increasing to High levels at diurnal peak on Days 3 and 4 (11 and 12 Nov) as previous HSS influence wanes. The associated fluence is excepted to persist below Active levels.

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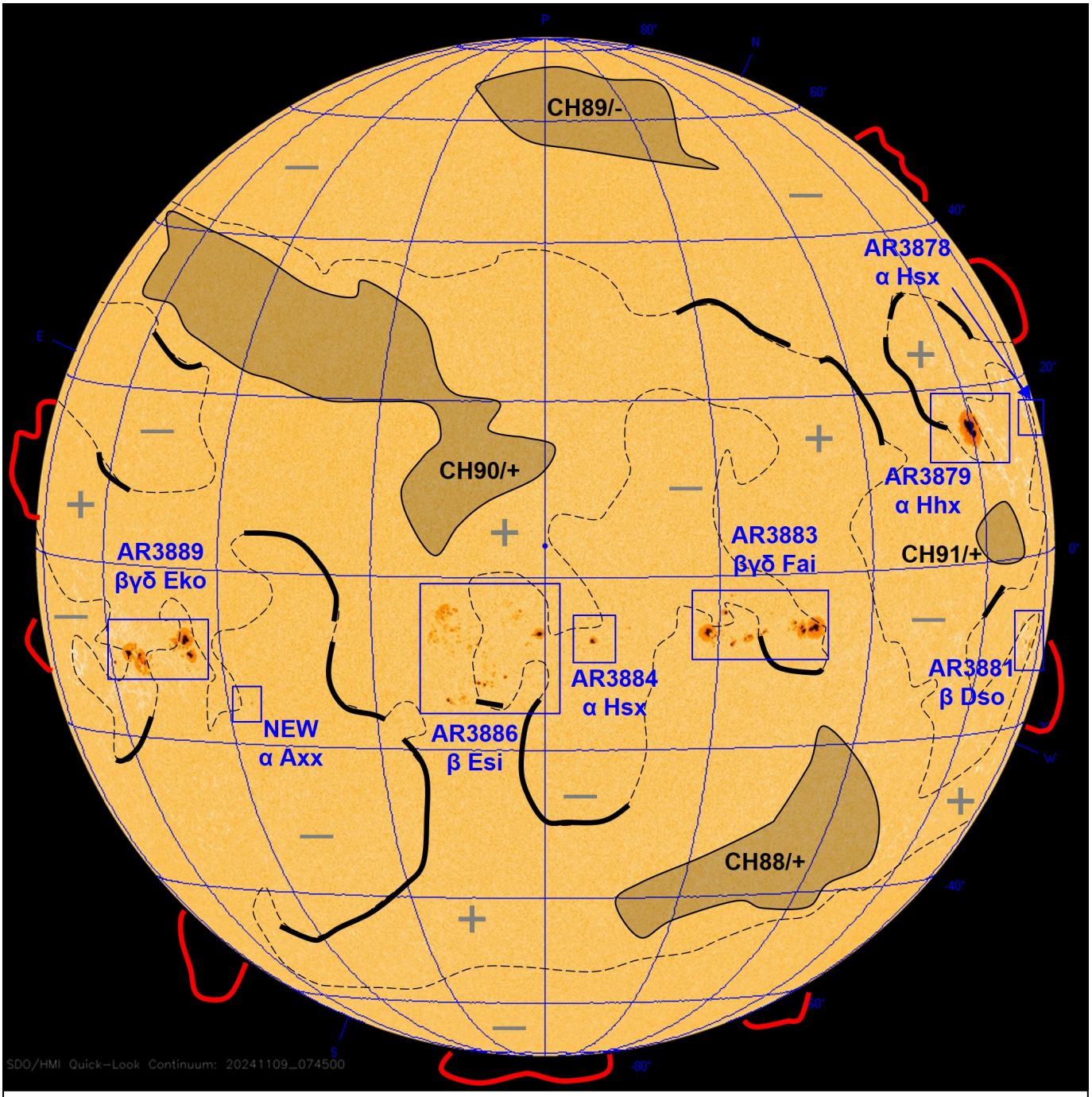
Figure 1: Solar synoptic map valid 09/0745



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs are currently forecast, however, some faint ejecta, mainly associated with occasional flare activity from AR3883 near centre-disc over the past couple of days, cannot completely be discounted as having some Earth directed trajectory late in the period. Any potential impacts, however, would be expected to be weak. Additionally, a number of long and large filaments on the facing-disc could disrupt and act as a source for Earth-directed CMEs in the coming days.

Solar winds are currently Slightly Elevated due to ongoing CME and perhaps coronal hole high speed stream influences from CH91/-. Slightly Elevated solar wind speeds are considered most likely, around 400-450 km/s before easing on Day 2 (10 Nov). Only limited Geomagnetic effects are expected, given that it is a negative polarity coronal hole.

MOSWOC's ENLIL model shows an ongoing significant enhancement from CH88/+ HSS influence with Strong solar wind speeds. This is considered too fast and far too early. The coronal hole is positioned quite far south on the disc with limited connection expected. If a connection were to occur then this may happen late Day 1 (09 Nov) or on Day 2 (10 Nov) until Day 3 (11 Nov), bringing Slightly Elevated to Elevated solar wind speeds. SWPM also offers poor guidance due to CME contamination on the last rotation. Speeds should trend back towards background levels during Day 4 (12 Nov).

Generally Quiet to Unsettled (Kp1-3) activity is forecast but with Active (Kp4) intervals likely and a slight chance of peak G1/Minor Storm conditions, mainly between Days 1-3 (09-11 Nov) due to generally minor CME and HSS influence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	20	20	15	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2:

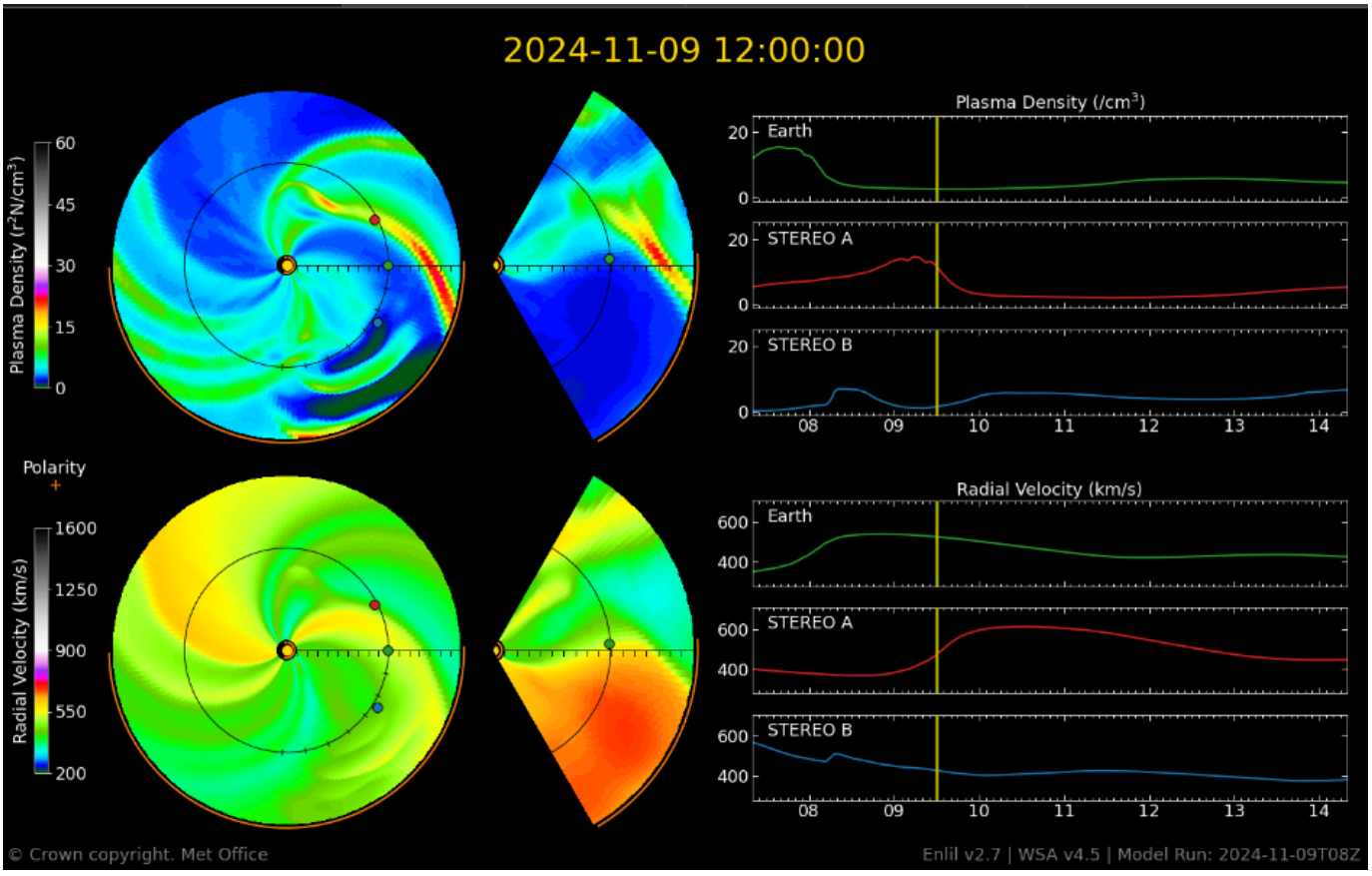
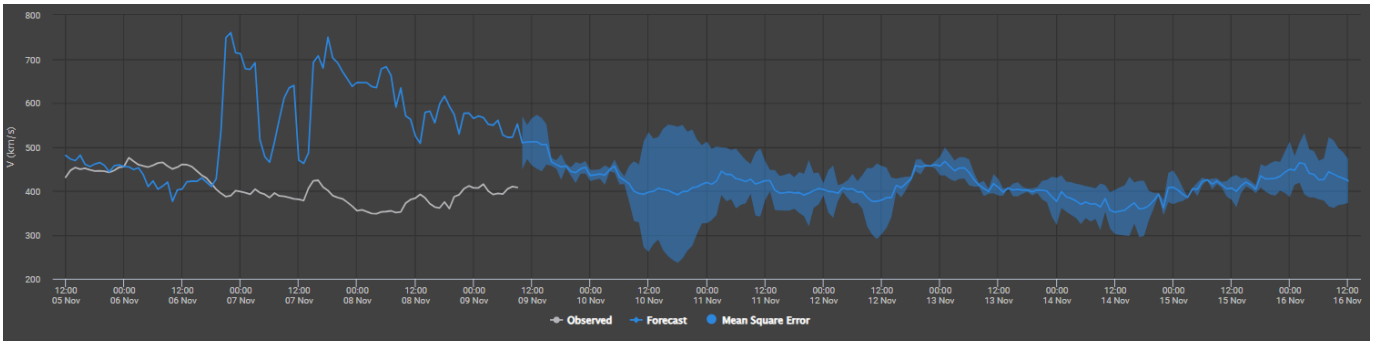


Figure 3: MOSWOC SWPM



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Radio Blackouts - X-Ray Flares

Solar activity has been Low, with both peak and baseline X-Ray flux within C-class levels in the past 24 hours.

There are currently eight sunspot regions on the visible disc. There are two large and complex regions present, though both have displayed signs of decay in recent hours. AR3889, in the southeast, contains a number of of mature spots and including at least one delta configuration in its trailing region, but now displays an open structure. AR3883, in the southwest, has mature leading and trailing spots, but has seen some decay in the spots occupying the intermediate region and the delta spot appears to continue fading. AR3886, in the southeast, approaching centre-disc, is a sparsely populated spot that consists of a number of small, mature spots and clusters of weaker spots extending longitudinally and latitudinally. This spot also continues a slow decline in penumbral area. AR3879 continues as a large single mature spot in the northwest, but has been inactive. The remaining spot regions are smaller and more magnetically simple.

Low to Moderate activity is forecast, with a likelihood of M-class flares and a slight chance of X-class flares, most probably from AR3883 or AR3889.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

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Figure 4: 24 hour X-ray flux.

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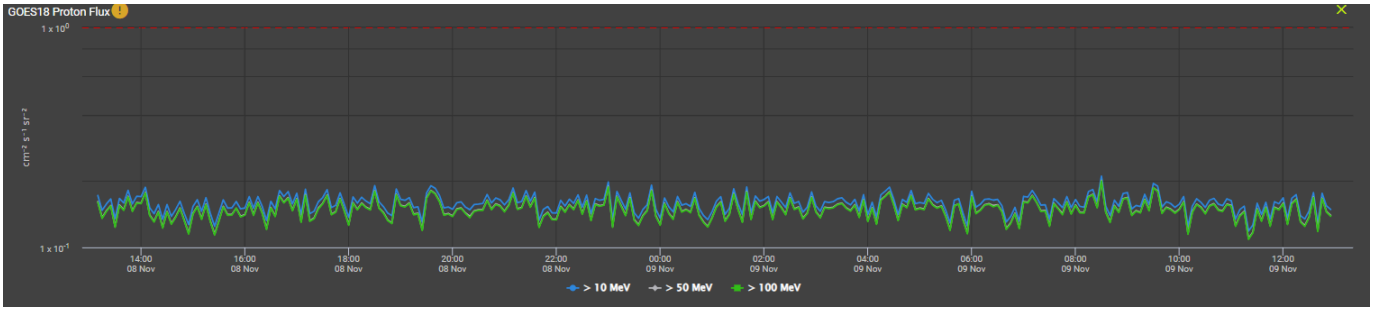
Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is at normal background levels. Many of the notable sunspots that currently occupy the Earth-facing disc are located in near centre disc or in the eastern hemisphere. There is a rising slight chance of S1/Minor Proton Storms or greater as many the larger regions on the disk rotate into more geoeffective positions in the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	15	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: 24 hour proton trace.



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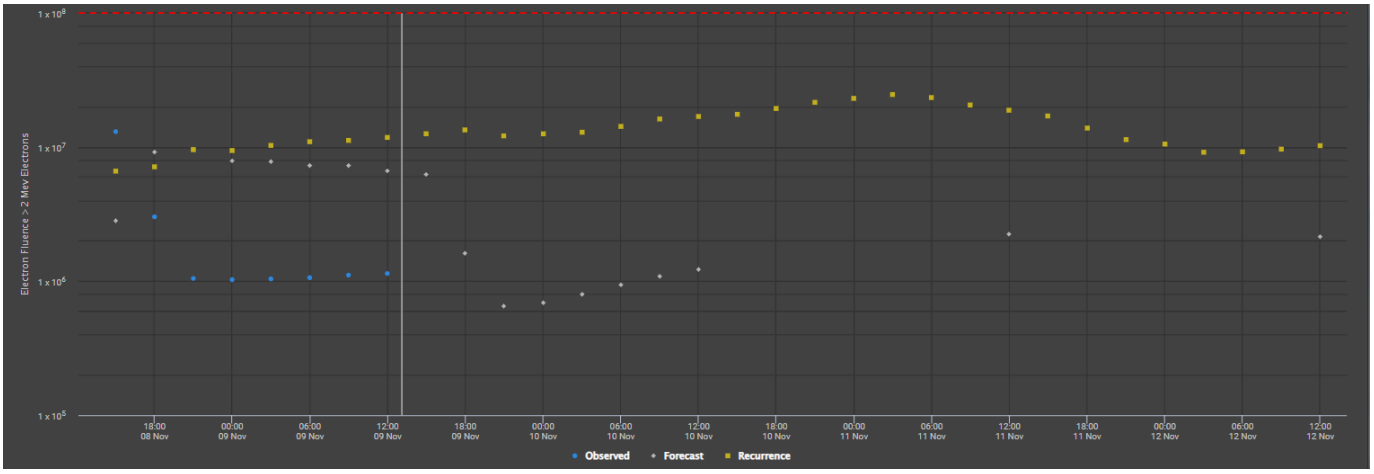
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is at background to Moderate levels.

The high energy electron flux is expected to remain background to Moderate at first, then potentially increasing to High levels at diurnal peak on Days 3 and 4 (11 and 12 Nov) as previous HSS influence wanes. The associated 24 hour fluence is expected to persist below Active levels, which corresponds with the guidance shown in MOSWOC REFM output. Therefore the REFM model is considered to be showing reasonable guidance, although an increasing trend is preferred late in the period.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 6: MOSWOC REFM fluence forecast/observations/recurrence.



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